F2 gene

coagulation factor II, thrombin

Normal Function

The *F2* gene provides instructions for making a protein called prothrombin (also called coagulation factor II). Coagulation factors are a group of related proteins that are essential for normal blood clotting (hemostasis). After an injury, clots protect the body by sealing off damaged blood vessels and preventing further blood loss.

Prothrombin is made chiefly by cells in the liver. The protein circulates in the bloodstream in an inactive form until an injury occurs that damages blood vessels. In response to injury, prothrombin is converted to its active form, thrombin. Thrombin then converts a protein called fibrinogen into fibrin, the primary protein that makes up blood clots.

Thrombin is also thought to be involved in cell growth and division (proliferation), tissue repair, and the formation of new blood vessels (angiogenesis).

Health Conditions Related to Genetic Changes

prothrombin deficiency

More than 50 mutations in the *F2* gene have been found to cause prothrombin deficiency. Most of these mutations change one protein building block (amino acid) in prothrombin. Some mutations drastically reduce the activity of prothrombin and can lead to severe bleeding episodes. Other mutations allow for a moderate amount of activity of prothrombin, typically causing mild bleeding episodes. None of the mutations identified eliminate prothrombin function. Researchers believe that people cannot live with a complete absence of prothrombin.

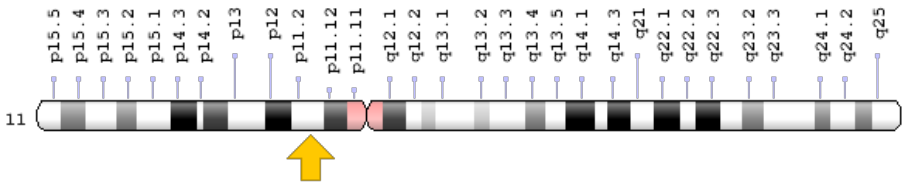
prothrombin thrombophilia

The mutation that causes most cases of prothrombin thrombophilia changes one DNA building block (nucleotide) in the *F2* gene. Specifically, it replaces the nucleotide guanine with the nucleotide adenine at position 20210 (written G20210A or 20210G>A). This mutation, which occurs in a region of the gene called the 3' untranslated region, causes the gene to be overactive and leads to the production of too much prothrombin. An abundance of prothrombin leads to more thrombin, which promotes the formation of blood clots.

Chromosomal Location

Cytogenetic Location: 11p11.2, which is the short (p) arm of chromosome 11 at position 11.2

Molecular Location: base pairs 46,719,166 to 46,739,508 on chromosome 11 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- Blood Coagulation Factor II
- coagulation factor II
- coagulation factor II (thrombin)
- prothrombin B-chain
- PT
- Q7Z7P3_HUMAN
- serine protease

Additional Information & Resources

Educational Resources

- Biochemistry (fifth edition, 2002): Prothrombin Is Readied for Activation by a Vitamin K-Dependent Modification
  https://www.ncbi.nlm.nih.gov/books/NBK22589/#A1406
- Guide to Peripheral and Cerebrovascular Intervention (first edition, 2004): Common hypercoagulable states: PT G20210A
  https://www.ncbi.nlm.nih.gov/books/NBK27369/#A1096
- National Center for Biotechnology Information: Mutations and Blood Clots
  https://www.ncbi.nlm.nih.gov/books/NBK2318/

GeneReviews

- Prothrombin-Related Thrombophilia
  https://www.ncbi.nlm.nih.gov/books/NBK1148

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28F2%5BTI%5D%29+OR+%28coagulation+factor+II%5BTI%5D%29+OR+%28prothrombin%5BTI%5D%29%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+720+days%22%5Bdp%5D

OMIM

- COAGULATION FACTOR II
  http://omim.org/entry/176930

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/GC_F2.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=F2%5Bgene%5D
- HGNC Gene Family: Endogenous ligands
  http://www.genenames.org/cgi-bin/genefamilies/set/542
- HGNC Gene Family: Gla domain containing
  http://www.genenames.org/cgi-bin/genefamilies/set/1250
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=3535
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/2147
- UniProt
  http://www.uniprot.org/uniprot/P00734

Sources for This Summary

- Akhavan S, Mannucci PM, Lak M, Mancuso G, Mazzucconi MG, Rocino A, Jenkins PV, Perkins SJ. Identification and three-dimensional structural analysis of nine novel mutations in patients with prothrombin deficiency. Thromb Haemost. 2000 Dec;84(6):989-97.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/11154146
- OMIM: COAGULATION FACTOR II
  http://omim.org/entry/176930

- Danckwardt S, Hartmann K, Gehring NH, Hentze MW, Kulozik AE. 3' end processing of the prothrombin mRNA in thrombophilia. Acta Haematol. 2006;115(3-4):192-7. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16549895
- Jayandharan G, Viswabandya A, Baidya S, Nair SC, Shaji RV, Chandy M, Srivastava A. Molecular genetics of hereditary prothrombin deficiency in Indian patients: identification of a novel Ala362 --> Thr (Prothrombin Vellore 1) mutation. J Thromb Haemost. 2005 Jul;3(7):1446-53.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15892853
- McGlennen RC, Key NS. Clinical and laboratory management of the prothrombin G20210A mutation. Arch Pathol Lab Med. 2002 Nov;126(11):1319-25. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12421139
- Spector EB, Grody WW, Matteson CJ, Palomaki GE, Bellissimo DB, Wolff DJ, Bradley LA, Prior TW, Feldman G, Popovich BW, Watson MS, Richards CS. Technical standards and guidelines: venous thromboembolism (Factor V Leiden and prothrombin 20210G >A testing): a disease-specific supplement to the standards and guidelines for clinical genetics laboratories. Genet Med. 2005 Jul-Aug;7(6):444-53.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16024978
- Varga EA, Moll S. Cardiology patient pages. Prothrombin 20210 mutation (factor II mutation). Circulation. 2004 Jul 20;110(3):e15-8.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15262854

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